Safety Data Sheet

Hydrazine

Division of Safety
National Institutes
of Health

WARNING!

THIS COMPOUND IS ABSORBED THROUGH THE SKIN AND THE RESPIRATORY AND INTESTINAL TRACTS. IT IS TOXIC, CARCINOGENIC, MUTAGENIC, AND TERATOGENIC. IT IS FLAMMABLE AND EXPLOSIVE AND MAY IRRITATE TISSUES. AVOID FORMATION AND BREATHING OF AEROSOLS AND VAPORS.

LABORATORY OPERATIONS SHOULD BE CONDUCTED IN A FUME HOOD, GLOVE BOX, OR VENTILATED CABINET.

AVOID SKIN CONTACT: IF EXPOSED, WASH WITH SOAP AND WATER.

FOR EYE EXPOSURE, IRRIGATE IMMEDIATELY WITH LARGE AMOUNTS OF WATER. FOR INGESTION, DRINK PLENTY OF MILK OR WATER. INDUCE VOMITING. FOR INHALATION, REMOVE VICTIM PROMPTLY TO CLEAN AIR. ADMINISTER RESCUE BREATHING IF NECESSARY. REFER TO PHYSICIAN.

IN CASE OF LABORATORY SPILL, WEAR PROTECTIVE CLOTHING DURING CLEANUP. AVOID SKIN CONTACT OR BREATHING OF AEROSOLS OR VAPORS. USE WATER TO DISSOLVE COMPOUND. WASH DOWN AREA WITH SOAP AND WATER. DISPOSE OF WASTE SOLUTIONS AND MATERIALS APPROPRIATELY.

A. Background

Hydrazine (HZ) is a colorless, volatile, hygroscopic liquid with an ammonia-like odor; it is flammable and is easily oxidized by atmospheric oxygen. HZ is a strong irritant to the eyes and respiratory tract, toxic in laboratory animals, and a carcinogen, mutagen, and teratogen in several species. It is used in the laboratory as a solvent and chemical intermediate. Its principal commercial uses are as rocket fuel, as a reducing agent (oxygen scavenger), and as an intermediate in the production of organic hydrazine derivatives (plant growth regulators, herbicides, drugs).

issued 8/82

hemical and Physical Data

1. Chemical Abstract No.: 302-01-2

2. Synonyms:

HZ	Diamide
Diamine	Hydrazine Base

3. Molecular formula: H_4N_2 structure: NH_2-NH_2

   weight: 32.06

4. Density: 1.008 g/cm^3.

5. Absorption spectroscopy: No data; mass spectra have been reported (Dibeler et al., 1958).

6. Volatility: Vapor pressure = 14.4 mm Hg at 25°C.

7. Solubility: Very soluble in water, ethanol, and most polar solvents.

8. Description, appearance, and odor: Colorless, oily, volatile, hygroscopic liquid with penetrating ammonia-like odor. Fumes in air.

9. Boiling point: 113.5°C.

   Melting point: 2°C.

10. Stability: Reacts violently with metal oxides (rust); unstable on exposure to ultraviolet light; decomposes at 300°C in absence of oxygen.

11. Chemical reactivity: HZ is a strong base and forms salts with mineral and organic acids. Reacts with alkyl halides to form monoalkyl and dialkyl hydrazines; as a powerful reducing agent, it is oxidized by compounds, such as peroxides, persulfates, iodate, and molybdate, often to nitrogen and water; reduces a variety of organic compounds and metal salts; and oxidizes to the free metal. Aqueous solutions of HZ are decomposed in the presence of catalytic amounts of chromium, ferric, cupric, aluminum, and nickel ions.

12. Flash point: 38-52°C, open cup.

13. Autoignition temperature: 23°C on rusty surfaces, 132°C on iron,

14. Flammable limits in air: 4.7-100%.

Fire, Explosion, and Reactivity Hazard Data

1. Use large amounts of water to extinguish fires and to minimize reignition and flashback hazard. Fire-fighting personnel should wear air-supplied respirators with full-face masks.

2. HZ is highly flammable and its vapors in air can produce explosive mixtures.

3. Conditions contributing to instability include exposure to atmospheric oxygen, heat, ultraviolet light, and presence of metal oxides (rust).

4. Incompatible with metals that form rust or other metallic oxides.

5. Incomplete oxidation may result in hazardous decomposition products (hydrogen, ammonia, hydrazoic acid).

6. Do not expose to sparks or open flames (HZ vapors explode when exposed to sparks at 100°C); use nonspark tools. Store in an explosion-safe refrigerator only.

Operational Procedures

The NIH Guidelines for the Laboratory Use of Chemical Carcinogens describe operational practices to be followed when potentially carcinogenic chemicals are used in NIH laboratories. The Guidelines should be consulted to identify the proper use conditions required and specific controls to be implemented during normal and complex operations or manipulations involving HZ.

HZ penetrates various glove materials (Luskus et al., 1980). This factor should be taken into account when handling HZ.

1. Chemical inactivation: No validated method reported.

2. Decontamination: Turn off equipment that could be affected by HZ or the materials used for cleanup. If more than 10 ml has been spilled or if there is any uncertainty regarding the procedures to be followed for decontamination, call the NIH Fire Department (dial 116) for assistance. Wash surfaces with copious quantities of water. Glassware should be rinsed (in a hood) with water and washed with soap and water. Animal cages should be washed with water.

3. Disposal: No waste streams containing HZ shall be disposed of in sinks or general refuse. Surplus HZ or chemical waste streams contaminated with HZ shall be handled as hazardous chemical waste and disposed of in accordance with the NIH chemical waste disposal

system. Nonchemical waste (e.g., animal carcasses and bedding) containing HZ shall be handled and packaged for incineration in accordance with the NIH medical-pathological waste disposal system. Potentially infectious waste (e.g., tissue cultures) containing HZ shall be packaged for incineration, as above. Burnable waste (e.g., absorbent bench top liners) minimally contaminated with HZ shall be handled as potentially infectious waste and packaged for incineration, as above. Absorbent materials (e.g., associated with spill cleanup) grossly contaminated shall be handled in accordance with the chemical waste disposal system. Radioactive waste containing HZ shall be handled in accordance with the NIH radioactive waste disposal system.

4. Storage: Store in sealed ampoules, in bottles with caps having polyethylene cone liners, or in screw-capped vials with Teflon liners in an explosion-safe refrigerator. For long-term storage, a freezer is preferred; however, stocks must be protected against moisture and brought to room temperature prior to sampling to avo introducing moisture.

Monitoring and Measurement Procedures Including Direct Field Measurements and Sampling for Subsequent Laboratory Analysis

1. Sampling: For quantitative measurements of air samples, glass bubblers charged with hydrochloric acid are used. For monitoring purposes, sampling and detection tubes, a personnel monitor (base on reduction of a metal salt and completing an electric circuit), and a dosimeter (colorimetric reaction, Plantz et al., 1968) have been developed; some of these items are commercially available. No special procedures have been developed for water sampling. Weeks et al. (1976) describe a method whereby surface samples are taken with filter paper, which is then moistened with ethanol fol lowed by addition of a fluorescence-producing agent.

2. Separation and analysis: Methods developed up to 1970 have been reviewed (Malone, 1970). Colorimetry, involving reaction with p-dimethylaminobenzaldehyde (Ehrlich's reagent), has been applied to determination of HZ in serum (minimal detectable level, 0.5 µg/ml) and in bubbler solutions from air sampling (minimal detect able level, 13 µg/m^3, using a 100-liter air sample). Other color reactions, based on reduction reactions with HZ, also exist but are subject to interference by other reducing agents. Greater specificity and/or sensitivity has been achieved by using TLC on the complex of HZ with Ehrlich's reagent (Bordun et al., 1977) or the Folin-Ciocalteau reagent (Fiala and Weisburger, 1975). A fairly specific GC procedure in which HZ is converted to a pyrazo derivative has been applied to aqueous solutions (Dee, 1971).

Biological Effects (Animal and Human)

1. Absorption: HZ is readily absorbed through the respiratory and

intestinal tracts and through the intact skin. Eye exposure causes severe irritation.

2. Distribution: Subcutaneous injection of HZ in rats results in distribution mainly to skeletal muscle, skin, blood, kidneys, and liver, with additional amounts to be found elsewhere.

3. Metabolism and excretion: HZ administered to dogs increases the blood ammonia level; a urinary excretion product in rats and rabbits is 1,2-diacetyl hydrazine (McKennis et al., 1959, 1961). Urinary excretion of HZ starts slowly but amounts to about 50% of the administered dose within 48 hours in rats and mice (Dambrauskas and Cornish, 1964) and in dogs (McKennis et al., 1955).

4. Toxic effects: The oral LD50 in mice and rats is 60 mg/kg, and the 4-hour inhalation LC50s are 252 and 570 ppm, respectively. Percutaneous LD50 is 91 mg/kg in the rabbit and 192 mg/kg in the guinea pig. The toxic effects of HZ are widespread with no particular target organ. Human exposure to HZ vapors immediately produces violent irritation of eyes (with heavy exposures resulting in temporary blindness), nose, and throat, followed by dizziness, nausea, and, occasionally, dermatitis (Comstock et al., 1954). In animals, toxic effects are particularly evident in the liver (fatty degeneration), kidney (lipid accumulation and necrosis), lung (hyperplasia, emphysema), and the central nervous system. The route of administration determines the main site of involvement.

5. Carcinogenic effects: In rodents, HZ administration produces tumors in the lung, liver, and mammary glands. There is no report of human cancer due to HZ.

6. Mutagenic and teratogenic effects: Mutagenic changes have been observed in several strains of bacteria and in the fruit fly. Teratogenic effects occur in chick and toad embryos.

Emergency Treatment

1. Skin and eye exposure: For skin exposure, remove contaminated clothing and wash skin with soap and water. Avoid raising skin temperature. For eye exposure, irrigate immediately with copious quantities of running water for at least 15 minutes.

2. Ingestion: Drink plenty of milk or water. Induce vomiting.

3. Inhalation: Remove victim promptly to clean air. Administer rescue breathing if necessary.

4. Refer to physician. Ophthalmological consultation and treatment for laryngeal and pulmonary irritation and edema may be required.

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